

LIVE FIRE TEST & EVALUATION

Overview

In FY86 Congress established the LFT&E program by passage of U.S. Code Title X, Section 2366. The Federal Acquisition Streamlining Act of FY95 moved responsibility for the program to DOT&E. The intent of the LFT&E program is to provide a timely and reasonable assessment of the survivability (vulnerability, susceptibility, and recoverability) and/or lethality of a system with particular attention on the prevention or minimization of user casualties. The LFT&E program requires realistic survivability and lethality testing on platforms and weapons to assure that major systems perform as expected and that combat forces are protected. The law has proven to be both enduring and flexible, permitting test realism to be balanced against cost and practicality.

Survivability and lethality testing generate data that directly supports the evaluation of the operational effectiveness, suitability, and survivability of major defense acquisition programs. Realistic lethality data are generated that, when combined with operational test and evaluation results, support an assessment of operational effectiveness. Realistic platform (e.g., aircraft, ship, armored vehicle) vulnerability data, damage assessment and reparability data, and crew casualty data are generated and analyzed. This analysis, in conjunction with susceptibility data and operational test and evaluation results, supports an evaluation of operational survivability.

INVESTMENT INITIATIVES

In support of its statutory requirements for system survivability and lethality testing and evaluation, the LFT&E office manages the programs and funding of several initiatives that encompass related efforts. These related efforts include increasing the coordination and integration of the testing and training communities, the testing and evaluation of fielded weapons and platforms, the production of munitions effectiveness manuals for the combatant commanders, and advancing of technologies and methodologies to increase aircraft survivability.

These established programs also provide DOT&E immediate access to test facilities and resources as well as to experts in the various test and evaluation-related communities. This access provides the opportunity to address urgent requirements from combatant commanders and the acquisition community. For example, DOT&E engaged the Joint Live Fire (JLF) program to investigate ground vehicle vulnerability when engineering explosives are stowed externally on a vehicle. This vulnerability was recognized during the conduct of an ongoing LFT&E program and had a potentially significant impact on deployed forces. Under JLF, testing was quickly planned and conducted to characterize the system vulnerability due to externally stowed explosives. Once this testing was completed, field expedient measures were defined that could be employed to reduce the vulnerability. These protective measures were made immediately available to deployed forces. Another example of the capability to respond quickly is the use during Operation Iraqi Freedom (OIF) of the Fast Assessment Strike Tool – Collateral Damage (FAST-CD) methodology developed in part with funding from the Live Fire Testing and Training (LFT&T) program. FAST-CD is a computer-based methodology used by mission planners to evaluate the risk and potential extent of collateral damage associated with the engagement of specific tactical targets. This methodology significantly increased the ability of the operational mission planners to quickly evaluate collateral damage risk and determine weapon assignment. This tool aided the combatant commanders in making target engagement decisions on sensitive high-value targets within the OIF theatre.

These investment initiatives are paying dividends within the test and evaluation and acquisition communities, as well as within the combatant commands. The individual programs and some examples of projects funded during FY03 are highlighted below.

LIVE FIRE TEST & EVALUATION

LIVE FIRE TESTING AND TRAINING

The FY97 Defense Appropriation included Congressional funding to investigate alternative uses of simulation and training technology in support of LFT&E. This initiative became the LFT&T Program and has been funded entirely by Congress.



The LFT&T Program fosters the exchange of technology initiatives and uses between the live fire and training communities. The underlying LFT&T Program objectives are to enhance cost-effective testing and training and to improve war-fighting readiness. Since inception, the program has funded 31 projects totaling approximately \$33M. Several projects have transitioned to operational sponsors and are already providing benefits to the warfighter. Congress did not fund the LFT&T Program for FY04. Due to the valuable and affordable products generated as a result of this program, DOT&E will attempt to provide internal funding to maintain the program until it can be established within the President's budget.

The LFT&T Program funded eight projects in FY03:

- **SPECIAL OPERATIONS FORCES SIGNALS TRAINING AND REHEARSAL SYSTEM (SOFSTARS):** This is an initiative that supports the Air Force Special Operations Command (AFSOC). It integrates live, virtual, and constructive simulations and national intelligence capabilities to provide aircrews with a realistic, simulated combat environment for distributed mission operations. SOFSTARS will support a full spectrum of activities to include mission preparation and planning, training, testing, mission rehearsal, and experimentation. SOFSTARS will interface with aircrew training devices, aircraft systems, mission planning/rehearsal tools, and other Services' assets required to provide a seamless AFSOC mission environment. SOFSTARS' capabilities will also be integrated into real-world Special Operations Forces and conventional operations, where applicable, to support ongoing missions.
- **PROJECT GRACE:** In the summer of 2003, Project Grace provided an opportunity for warfighters to observe and evaluate the MiG-29 as a total weapons system during a German Air Force MiG-29 deployment to the U.S. Currently, the aircraft, weapons, fire control system, and helmet-mounted display are assessed independently and a total weapons system capability is then extrapolated from the results of these independent assessments. The weapon system evaluation made during Project Grace will ensure that future U.S. and allies' tactics, testing, and training are based on complete and accurate knowledge of MiG-29 system capabilities.
- **SUPER FAST ASSESSMENT STRIKE TOOL—COLLATERAL DAMAGE (Super FAST-CD):** Super FAST-CD improves the FAST-CD tool currently used by combatant commanders and component staff to estimate expected collateral damage in potential target areas. Super FAST-CD will improve the warfighters' ability to conduct time-critical operations by decreasing decision timelines and by allowing warfighters to optimize the selection of precision munitions against targets that are in or near congested or protected zones.
- **ADVANCED ROBOTICS TEST BED (ARTB):** ARTB is developing a dynamically composable robotic test bed that will provide the capability to analyze tactics and train with unmanned forces in a collaborative environment. This capability will be essential for all Services using unmanned vehicles in their warfighting force structure and operations. With the development of the ARTB, survivability and lethality studies can be conducted on individual platforms, as well as analyses of total system-of-systems' performance.
- **OBJECTIVE INDIVIDUAL COMBAT WEAPON (OICW) EMBEDDED SIMULATION, TRAINING, AND INSTRUMENTATION:** This project will provide a technology solution to support an embedded capability for the OICW in simulation systems used by the Army Research, Development, and Engineering Command and the Dismounted Battlespace Battle Lab. This capability will assist warfighters in assessing new solutions to their individual combat weaponry and tactics requirements for the future.
- **MOVING WEAPONS PLATFORM SIMULATOR (MWEPS):** MWEPS will be a system that allows weapons' concepts to be evaluated on a motion-based platform earlier in the design process, reducing the time required for developmental testing. It will also serve as an individual weapons operator training system and will be the baseline system for defining system operator training requirements. The Naval Surface Warfare Center has

LIVE FIRE TEST & EVALUATION

already used a prototype version of MWEPS to support the testing of remote-controlled small arms mounts on a motion-based platform, avoiding the expenditure for live ammunition and a target to calibrate the stabilized mount and auto tracker system. The fully developed MWEPS will provide cost avoidance for testing and training applications on a wide variety of air, land, and sea platforms.

- **JOINT DISTRIBUTED INTEGRATED TEST AND TRAINING SYSTEM:** This project expands Virtual At-Sea Trainer (VAST) technology (developed in an earlier LFT&T project) that scores the performance of Navy weapon systems at sea. This follow-on initiative will demonstrate a virtual, transportable “range” for the end-to-end test and evaluation of extended range weapon systems and will increase training and mission planning capabilities using an enhanced 3-D visualization system for projecting the detailed location of any desired target. The system is being designed to evaluate land, sea or air-launched weapons, as well as providing increased training and mission planning capabilities using an enhanced 3-D visualization system. Because the Navy selected this system as a near-term replacement of the range capabilities at Vieques, DOT&E has accelerated the development of this program.
- **MULTIPURPOSE SUPPORTING ARMS TRAINER:** This project will apply the latest display technologies, synthetic terrain viewers, and scenario development techniques to the development of a prototype multipurpose terminal control and supporting arms trainer. The trainer will provide a joint, standardized system for instruction in the employment and techniques for communicating requirements for Naval surface fire, tactical air, and field artillery support in expeditionary operations. Each Service currently performs these requirements differently. The Joint Forward Air Controller community estimates that operational and maintenance costs could be reduced by 50 percent by accomplishing close-air support coordination and pilot proficiency training via a synthetic training environment.

JOINT LIVE FIRE PROGRAM

OSD initiated the JLF Program in March 1984 to establish a formal process for the test and evaluation of fielded U.S. systems against realistic threats. This process continues today, taking into account changes in operational scenarios, changes in threat munitions and targets, and the testing of legacy systems. JLF provides a means to gather additional data not collected by acquisition programs. It contributes to survivability and lethality assessments of fielded systems or for upgrade programs that do not qualify as a formal LFT&E program.

The JLF program consists of three groups: Aircraft Systems (JLF/AS), Armor/Anti-Armor (JLF/A/AA), and Sea Systems (JLF/SS). The focus of each of these groups is:

- **JLF/AS:** Vulnerability of U.S. fixed-wing and rotary-wing aircraft to realistic threats and on the lethality of fielded U.S. weapons/munitions against foreign aircraft.
- **JLF/A/AA:** Vulnerability of fielded U.S. ground systems (e.g., tanks, armored personnel carriers) to realistic threats and on the lethality of fielded U.S. weapons/munitions against realistic targets.
- **JLF/SS:** Vulnerability of fielded surface combatants and on the lethality of fielded U.S. weapons/munitions against realistic targets.

LIVE FIRE TEST & EVALUATION

In FY03, the JLF/AS program addressed the vulnerability of rotorcraft to rocket propelled grenades, the vulnerability of close-air support aircraft to a new 35mm airburst munition and the vulnerability of the H-60, CH-53, and Predator Unmanned Air Vehicle (UAV) to ballistic threats.



- **TRI-SERVICE ROTORCRAFT VULNERABILITY TO ROCKET-PROPELLED GRENADES (RPG):** RPGs are multipurpose weapons that are employed against lightly armored targets such as armored personnel carriers, transport trucks, or patrol boats. Due to the low cost and rugged characteristics of these weapons, they are widely used around the world. To demonstrate the lethality of RPG weapons against rotorcraft, a joint Army, Navy, and Air Force effort was initiated to investigate vulnerability of helicopters, demonstrate the lethality of fragment spraying patterns of RPG warheads, and to demonstrate direct impact lethality of the RPG against rotorcraft. During FY03, the Army and Navy completed their planning and target acquisition efforts. Testing during FY04 will include characterization of the RPG fuze function against soft targets and the characterization of the RPG fragment pattern.
- **35MM AIR BURST MUNITION EVALUATION AGAINST CLOSE-AIR SUPPORT AIRCRAFT:** This project is evaluating the lethality of the 35mm Advance Hit Efficiency and Destruction round against close-air support aircraft. This munition is a modern, shot-by-shot programmable, highly effective fragmentation threat used as an area air-defense weapon. This munition is a new generation programmable round that is considered a serious threat to U.S. aircraft and ground attack weapon systems.
- **TRI-SERVICE H-60 ENGINE NACELLE BALLISTIC FIRE SUPPRESSION:** This three-year tri-Service project will evaluate the effectiveness and vulnerabilities of existing H-60 engine nacelle Halon 1301 suppression systems under the changing conditions resulting from combat damage. The testing will also provide opportunities for the evaluation of Halon alternative agents. The data from these tests will be used to reduce ballistic vulnerabilities of nacelle fire suppression system designs.
- **CH-53E VULNERABILITY TO ANTI-AIRCRAFT ARTILLERY:** There is little combat data and no test data on CH-53E vulnerability to small and medium ballistic munition threats. Any vulnerability reduction features identified in the JLF testing could be included in the new CH-53E service life extension program. Testing will include dynamic ballistic tests of the rotor and drive systems and ballistic testing of the fuel systems.
- **PREDATOR WING VULNERABILITY:** This test empirically and analytically assesses the ballistic vulnerability of the RQ-1L Predator UAV composite wing to threat ballistic projectiles expected to be encountered during its operational mission. Ballistic munition tests will be conducted on a pair of operational wings for one year.

In FY03 the JLF/A/AA program evaluated the lethality of U.S. munitions against a foreign main battle tank and a foreign missile launcher, evaluated the sensitivity of stowed munitions on ground vehicles, and conducted blast overpressure testing to provide empirical data for an emerging modeling methodology.



LIVE FIRE TEST & EVALUATION

- **MUNITIONS LETHALITY:** Lethality testing was continued against a classified foreign main battle tank. These tests were started in FY01 and will conclude in FY04. The objectives of these tests are to:
 - Assess the lethality of current and developmental U.S. munitions.
 - Acquire empirical data to calibrate current vulnerability methodologies.
 - Update existing JLF and LFT&E databases.
 - Supplement live fire lethality tests and evaluations for the tested munitions.
 - Provide data to assist field commanders in training on how to engage and defeat the tested threat target.

The results will be incorporated in the JTCG/ME manuals for munitions effectiveness.

- **MUNITIONS LETHALITY AGAINST SCUD-B TARGET:** Lethality testing of several U.S. munitions against the SCUD-B ballistic missile target continued. Two test events were conducted against chemical warhead surrogates to determine the potential for destroying chemical warheads and the potential hazard posed by release of warhead contents. Data are currently being analyzed and will be used by the JTCG/ME to update joint munitions effectiveness manuals.
- **PROPAGATION OF DETONATION OF STOWED BULK DETONATING CORD AND COMPOSITION-4:** A vulnerability recently identified during an LFT&E test event of a ground system potentially posed a significant impact to operationally deployed forces. JLF funded an experiment to determine detonation and propagation thresholds for externally stowed engineering explosives (C-4, detonation cord). Additionally, data were generated to indicate the likelihood of detonation propagation between some dissimilar Class V items. Field expedient vulnerability reduction techniques were evaluated and recommended actions were transmitted to the combatant commanders via an Ammunition Information Notice.
- **BLAST OVERPRESSURE TESTING IN SUPPORT OF THE BLAST EFFECTS AGAINST MOBILE SYSTEMS (BEAMS) METHODOLOGY:** Blast testing against a former Soviet Union STYX missile launcher was conducted to obtain experimental data to aid in the validation efforts of the BEAMS model. Pretest predictions were made using the BEAMS model and served as the basis for establishing the initial standoff distances. Post-shot analyses of the structure and material properties updates are currently being completed in order to revise the BEAMS predictions.

In FY03, the JLF/SS program demonstrated HELLFIRE Missile lethality against an aluminum-hulled Mark III Patrol Boat. Data and damage assessment collected and analyzed will be used by the JTCG/ME to address systems' effectiveness against small boat threats. Also in FY03, JLF/SS began planning for several tests to investigate fire spread in confined enclosures such as below-decks on submarines and surface combatant vessels.



JOINT TECHNICAL COORDINATING GROUP FOR MUNITIONS EFFECTIVENESS (JTCG/ME)

The Joint Logistics Commanders chartered the JTCG/ME over 30 years ago to serve as DoD's focal point for authenticated non-nuclear munitions effectiveness information. The JTCG/ME's efforts include validating, standardizing, and disseminating modeling and simulation methodologies for evaluating the lethality of U.S. munition systems. The JTCG/ME authenticates data and methodology for use in training, systems acquisition, weaponeering, procurement, and combat modeling. Joint munitions effectiveness manuals (JMEMs) are used by the U.S. Armed Forces, NATO, and other allies to plan operational missions, support training and tactics development, and support force-level

LIVE FIRE TEST & EVALUATION

analyses. The JTCG/ME also develops and standardizes methodologies for the evaluation of munitions effectiveness and maintains databases for target vulnerability, munitions lethality, and weapon system accuracy.

In FY03, the JTCG/ME:

- Enhanced the operational tools and data in the following JMEMs: Air-to-Surface Weaponing System, including two interim versions in support of Operation Enduring Freedom and Operation Iraqi Freedom; Joint Anti-Air Combat Effectiveness; and Surface-to-Surface Weaponing Effectiveness System.
- Increased support to the warfighter by distributing products and product updates via the classified Internet with the JTCG/ME Products and Information Access System.
- Continued updating existing databases to incorporate weapons effectiveness and target vulnerability data for 33 new air-to-surface targets and 17 new surface-to-surface targets.
- Continued execution and technical coordination efforts to address target vulnerability data generation for a full spectrum of strike weapons against approximately 50 targets.
- Coordinated with Joint Chiefs of Staff to develop instructions to codify the command requirements data call and prioritization to support the FY04 JTCG/ME program.
- In collaboration with the Defense Intelligence Agency and Service intelligence centers, initiated intelligence collection and production requirements process and conducted review and analysis of intelligence data packages in support of target geometry development.

JOINT AIRCRAFT SURVIVABILITY PROGRAM (JASP)

The Joint Aeronautical Commanders Group established JASP by Charter in January 2003 through the integration of the JTCG on Aircraft Survivability, the Joint Live Fire Aircraft Systems program, the Joint Combat Assessment Team, and the Joint Accreditation Support Activity. The program focuses on establishing aircraft survivability as a design discipline. It develops vulnerability and susceptibility reduction technologies, provides standard accredited models to assess aircraft survivability, supports combat survivability education, collects combat damage data for analysis, and conducts JLF tests on combat aircraft. The JASP is the military's only tri-Service organization solely dedicated to advancing aircraft combat survivability.

In FY03, JASP worked closely with members of the defense acquisition community, as well as the Federal Aviation Administration, the Transportation Security Administration, and National Aeronautics and Space Administration, to identify critical issues regarding aircraft survivability. Accordingly, JASP funded approximately \$8.4M for 61 survivability projects and funded approximately \$1.5M for nine JLF test projects. JASP projects are grouped in three categories: susceptibility reduction, vulnerability reduction, and survivability assessment.

Examples of these projects are:

- **SUSCEPTIBILITY REDUCTION:**
 - The UAV Active Acoustic Cancellation project will measure radiation patterns and spectral content of acoustic emissions from push/pull propeller-driven UAVs and will then determine passive and active signature reduction techniques.
 - The Imaging Seeker Aim Point project's objective is to determine how to counter imaging infrared seekers in threat missiles.
 - The Aero Urban Decoy project will develop an inexpensive aero stable flare, safe for deployment in low-altitude environments and capable of protecting low-flying, large, fixed-wing aircraft.
- **VULNERABILITY REDUCTION:**
 - The Man Portable Air Defense System (MANPADS) Impact Point Assessment project will validate the ability of MANPADS fly-out and endgame modeling to discriminate between adjacent infrared targets and predict hit points.

LIVE FIRE TEST & EVALUATION

- The Advanced Survivable Rotorcraft Validation project will enhance the technology base for the design of hardened rotorcraft structures. This project will also validate a low-cost, low-weight MANPADS hit-point biasing concept.
- The Joint Resistance to Ram project characterized inherent hydraulic ram resistance and failure criteria as a function of joint design.
- SURVIVABILITY ASSESSMENT:
 - The Dry Bay Fire Model (DBFM) Enhancements project, together with the JTTCG/ME, is developing a standard dry bay fire model and a fuel tank ullage explosion model for stand-alone analysis. The DBFM will provide the framework to enable modeling of physical threat/target interactions that cannot be done within current models such as hydrodynamic ram filling the dry bay, fire pooling and spread, airflow within the dry bay with clutter, and time-dependent damage.
 - The JASP funds the Survivability/Vulnerability Information Analysis Center (SURVIAC) Model and Simulation Accreditation Support Information project to provide a credibility assessment of the survivability and vulnerability models and simulations that are distributed by SURVIAC.

